

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

SURFACE DRAINAGE, MAIN OR LATERAL

(Feet)

CODE 608

DEFINITION

An open drainage ditch constructed to a designed size and grade.

PURPOSE

To dispose of excess surface or subsurface water, intercept ground water, control ground water levels, provide for leaching of saline or alkali soils, or a combination of these objectives.

CONDITIONS WHERE PRACTICE APPLIES

All lands to be drained shall be suitable for agriculture after installation of required drainage and other conservation practices.

In areas where an outlet for the drainage system will be available, either by gravity flow or by pumping. The outlet shall provide for the quantity and quality of water to be disposed of. Consideration shall be given to possible damages above or below the point of discharge that might involve legal actions.

CRITERIA

The design and installation shall be based on adequate surveys and investigations.

Drainage Requirements. Mains and laterals shall be located and designed to serve as integral parts of a surface or subsurface drainage system that meets the conservation and land use needs. The degree of drainage required by the crops shall be determined and expressed in terms of drainage coefficients or depth and spacing of drains.

Capacity. The ditch capacity shall be adequate to provide for the removal of excess water, based on climatic and soil conditions and the needs of crops. The required capacity shall be obtained by determining the watershed area; the required topographic, soil, and land use information; and use of the appropriate drainage coefficient curves.

The required capacity of open ditches for subsurface drainage in western irrigated areas shall be determined by evaluating site conditions, including irrigation water deliveries, irrigation canal or ditch losses, soil stratification and permeability, deep percolation losses, field irrigation losses, subsurface drain discharge, and quantity of surface water to be carried by the drainage ditch.

Hydraulic Gradeline. The hydraulic gradeline for drainage ditch design shall be determined from control points, including elevations of significant low areas served by the ditch and hydraulic gradelines of any tributary ditches and the outlet. If control point elevations are estimated rather than computed from survey data, the hydraulic gradeline shall be no less than:

- 1 ft. below fields that will receive normal drainage from ditches draining more than 1 mi².
- 0.5 ft for ditches draining 40 to 640 acres.
- 0.3 ft for ditches draining less than 40 acres.

For lands to be used only for water-tolerant crops, such as trees and grasses, these requirements may be modified and the

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hydraulic gradeline set at ground level. These provisions do not apply to channels where flow is contained by dikes.

The effects of hydraulic losses caused by culverts, bridges, or other obstructions in the channel section shall be considered.

Depth. Drainage ditches shall be designed deep enough to allow for normal siltation. If needed, the design depth and capacity may be increased to provide adequate subsurface drainage or for normal flow. The increase shall be based on an evaluation of site conditions. Ditches that serve as outlets for subsurface drains shall be designed for a normal water surface at or below the invert of the outlet end of the drain. The clearance between a drain invert and the ditch bottom shall be least 1 ft. for ditches that fill with sediment at a normal rate, except where lower values are specified for a job because of unusual site conditions. The normal water surface is the elevation of the usual low flow during the growing season.

Cross Section. The design ditch cross section shall be set below the design hydraulic gradeline and shall meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and, if needed, allowances for initial sedimentation. Side slopes shall be stable, shall meet maintenance requirements, and shall be designed on the basis of on-site conditions.

Velocity. The maximum permissible design velocity shall be based on site conditions and shall insure stability of the ditch bottom and side slopes. A desirable minimum velocity is 1.5 ft/s. On flat grades, a channel cross section shall be selected on the basis of the depth and maintenance requirements, which will result in the desirable minimum velocity if possible.

The velocity for newly constructed channels with drainage areas in excess of 1 mi² shall meet the stability requirements specified for Open Channels (582).

Capacity design. Manning's Formula shall be used in determining the design velocity, and the value of n shall be based on alignment, probable vegetative growth expected with

normal maintenance, other roughness factors, and the hydraulic radius. Unless special site studies are available to justify other values, the following values of n , based on the hydraulic radius of the channel and assuming an aged channel with good maintenance and good alignment, shall be used in solving the Manning Formula for mains and laterals when determining the design for required capacity.

Hydraulic radius	n
Less than 2.5	.040 — .045
2.5 to 4.0	.035 — .040
4.1 to 5.0	.030 — .035
More than 5.0	.025 — .030

Berms and Spoil Banks. Adequate berms shall be provided and shaped, as required, to provide access for maintenance equipment, to eliminate the need for moving spoil banks in future operations, to provide for work areas and facilitate spoilbank spreading, to prevent excavated material from washing or rolling back into ditches, and to lessen sloughing of ditchbanks caused by heavy loads too near the edge of the ditchbanks. The following minimum berm widths shall be provided, except where spoil is spread according to the engineering standard for spoilbank spreading:

Ditch depth	Minimum berm width
<i>Ft</i>	<i>ft</i>
2 — 6	8
6 — 8	10
More than 8	15

If spoil material is to be placed in banks along the ditch rather than spread over adjacent fields, the spoilbanks shall have stable side slopes. Provision must be made to channel water through the spoil and into the ditch without causing serious erosion.

Travelways for Maintenance. All drainage mains and laterals with drainage areas in excess of one square mile shall be provided with travelways for maintenance as specified in standard 582 – Open Channel.

Related structures and ditch protection. Mains and laterals shall be protected against erosion by chutes, drop structures, pipe drops, other suitable structures or grassed waterways, or specially graded channel entrances where

surface water or shallow ditches enter deeper ditches.

Grade control structures, bank protection, or other suitable measures shall be used if necessary to reduce velocities and control erosion.

Culverts and bridges shall have enough hydraulic capacity and depth for drainage needs and to minimize obstruction to flow.

Capacities of pipe or drop structures generally shall be determined by use of the applicable drainage coefficients with the "island-type" of construction used to protect the structure from washout.

Each structure for an open ditch system shall be designed according to NRCS standards for the kind of structure and type of construction used.

Channel Vegetation. Vegetation shall be established according to the standard for Channel Vegetation (322) or Critical Area Seeding (342). Areas shall be fenced where necessary to protect the vegetation.

CONSIDERATIONS

Water Quantity

1. Effects on the water budget components, especially with regard to effect on runoff, soil water, and water tables.
2. Potential changes in soil moisture that will affect the growth of desirable vegetation.
3. Effect on ground water recharge.

Water Quality

1. Effects on the detachment and transport of sediment and chemicals and dissolved and sediment-attached substances into water courses.

2. Effects on the salinity of drained soils and downstream watercourses.
3. Effects on wetlands.
4. Effect on the quality of ground water.
5. Potential for changes in downstream water temperatures.
6. Effects on downstream visual quality.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing mains or laterals shall be in keeping with this standard and shall describe the requirements for constructing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan shall be prepared for Surface Drainage Mains and Laterals and any other associated conservation practices that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. Requirements for operating and maintaining all drainage mains and laterals having drainage areas in excess of 1 mi² shall be according to the standard for Open Channels (582).

Maintenance needs are to be discussed with the landowner or operator who is responsible for maintaining the practices installed with NRCS assistance. Any hazards must be brought to the attention of the responsible person. Prior to construction, sufficient copies of the O&M plan shall be provided to the owner/operator, designer, and approving agencies. The owner shall sign the O&M plan to indicate an understanding of the requirements and a commitment to operate and maintain the area as specified.

MAIN OR LATERAL SPECIFICATIONS

CLEARING

The channel area shall be cleared of trees, logs, stumps, and other materials necessary for construction. Care must be taken to protect all trees to be saved for environmental purposes. [Proper disposal of material shall be as described in the plans and specifications or as designated by the on-site NRCS representative.](#)

EXCAVATION

Channels shall be excavated to line and grade as shown on the plans or as staked in the field. The excavated surface shall be reasonably smooth. Construction activities shall be carried on in a manner that will not restrict flow from upstream channels. Care must be taken to reduce and prevent pollution of water.

SPOIL

[Proper disposal of spoil shall be as described in the plans and specifications or as designated by the on-site NRCS representative.](#)

STRUCTURES

All structures and other related protection devices shall be installed as the work progresses to permit proper functioning of the ditch and to prevent environmental damage during the installation period.

VEGETATION

Vegetation shall be planted at times and rates shown in the plans or in the specifications for each job.